

STAR V-124 Timing Setup

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The object is to program three channels of the STAR (set-2) V-124 so that they identify bunches that undergo 2-, 3- and 4-crossings at interaction points at RHIC. After suitable phase adjustment, these signals are put into coincidence with collision signals from the STAR BBC.

Procedure

1) The set-1 V-124 phase delay was chosen to reproduce STAR trigger timing from p+p collisions in runs 2 and 3. The V-124 coarse and fine delay values that reproduce the trigger timing to within ~ 2 ns are coarse delay = 95 ticks and fine delay = 0 ns. With these settings STAR run 5106018 was taken with a BBC E.W coincidence trigger. The bunch counter distribution of events is shown in Fig. 1.

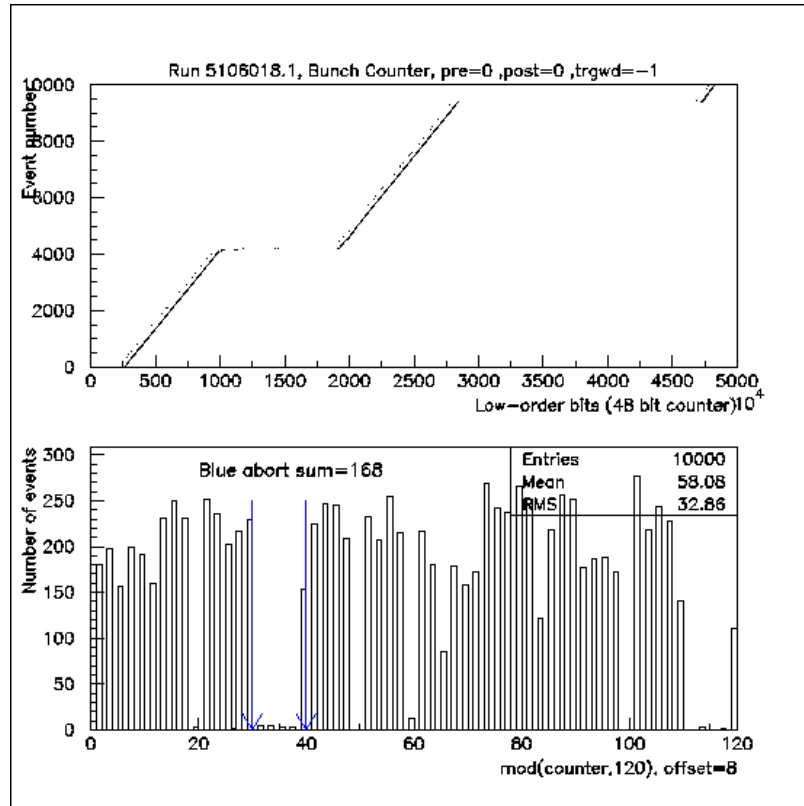


Figure 1 Data from STAR run 5106018 after adjustment of V-124 timing, setting coarse delay to 95 ticks and fine delay of V-124/set-1 Yellow channel 7 (STAR experimental clock) to 0 ns. The top figure shows the event number on the y-axis and the 48-bit bunch counter on the x-axis. The bottom figure shows the number of events versus the remainder, after dividing the bunch counter by 120. This operation identifies the bunch crossing at STAR. The Blue beam abort gap is for bunch crossing values from 30-39 and the Yellow beam abort gap is for bunch crossing values from 110-119. The abort gap identifications are based on a fill pattern shown in Fig. 2.

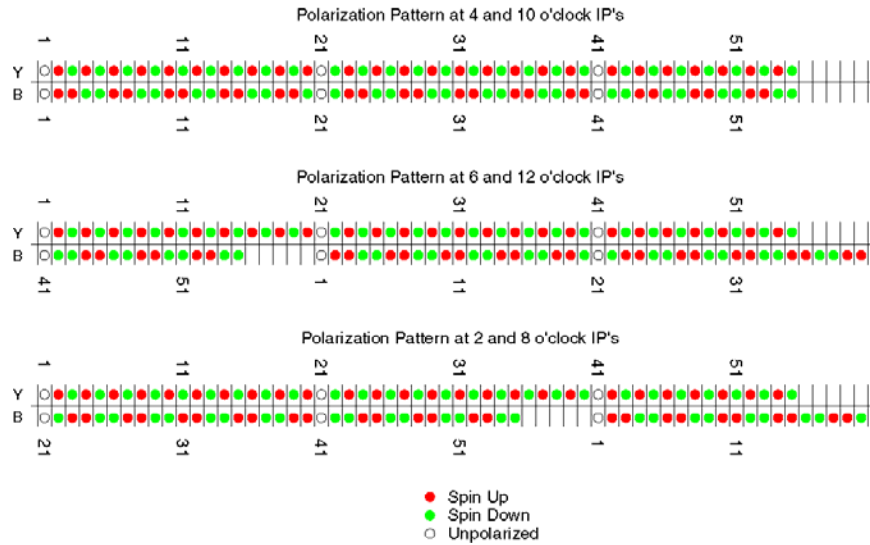
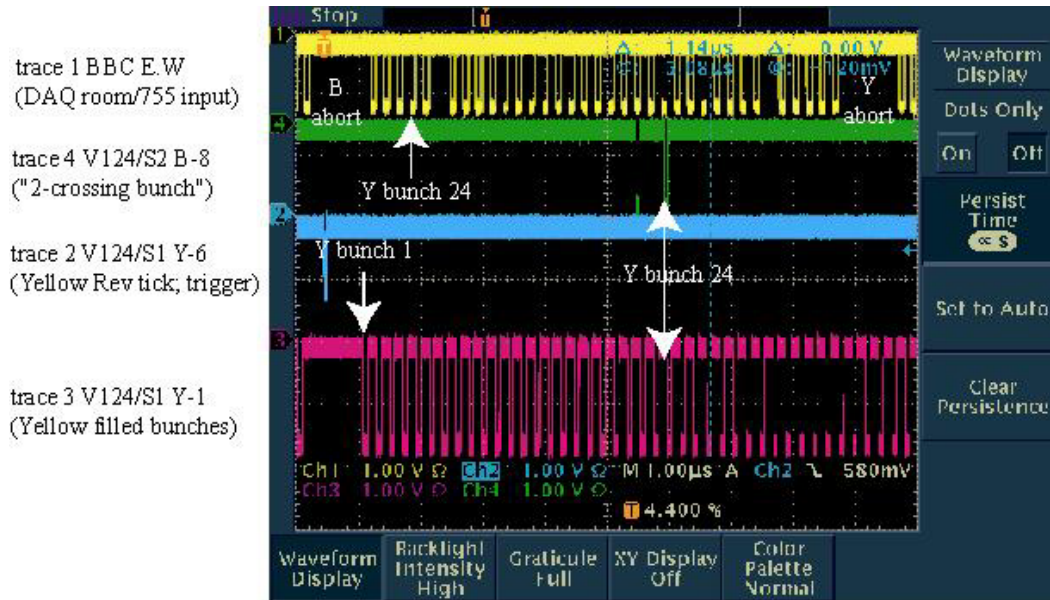


Figure 2 Bunch patterns at RHIC interaction points. The polarization pattern is specific to one used in RHIC run 2. The fill pattern corresponds to 55 bunches in each ring. The data in Fig. 1 corresponds to 56 bunches in each ring.

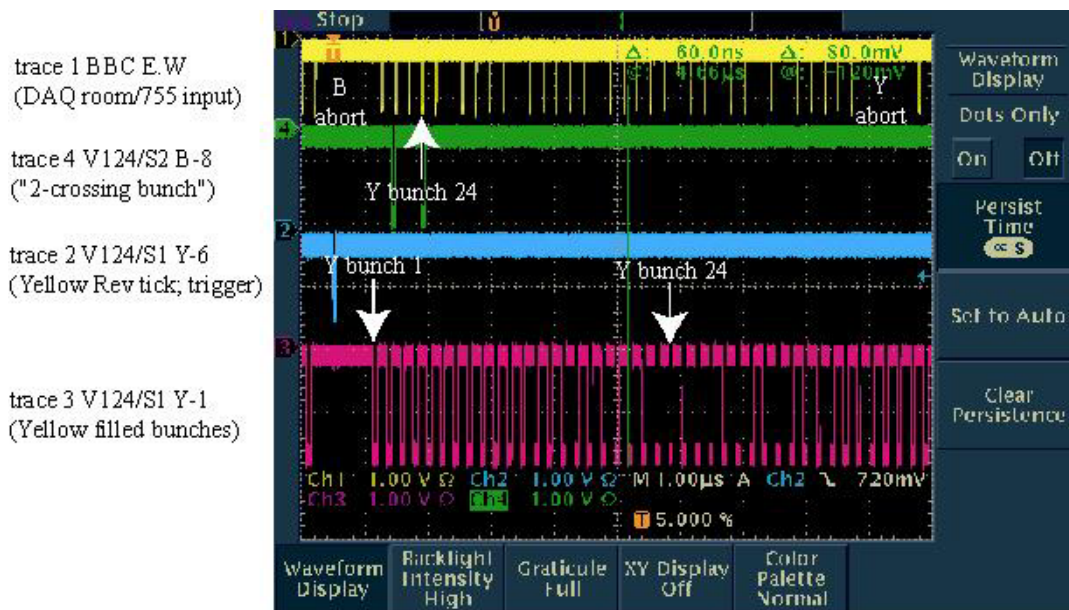
2) The delay settings of the V-124/set-2 Blue channel-8 (nominally, 2-crossing bunches) were set to the same value as for the V-124/set-1 Yellow channels 1 (filled bunches in Yellow), 6 (“rev tick”) and 7 (STAR experimental clock). Then, V-124 channels and the BBC E.W coincidence signal (available in the STAR DAQ room) were looked at on an oscilloscope. This allowed correspondence of the BBC trigger with the V-124 Yellow ring fill pattern, and identification of what phase delay was necessary for the V-124/set-2 Blue channel-8.



V124 coarse delay = 95 ticks V124 fine delay = 0 ns
for channels Y-1,6 (Yellow) set 1 (S1),
and channels B-8 (Blue) set 2 (S2).

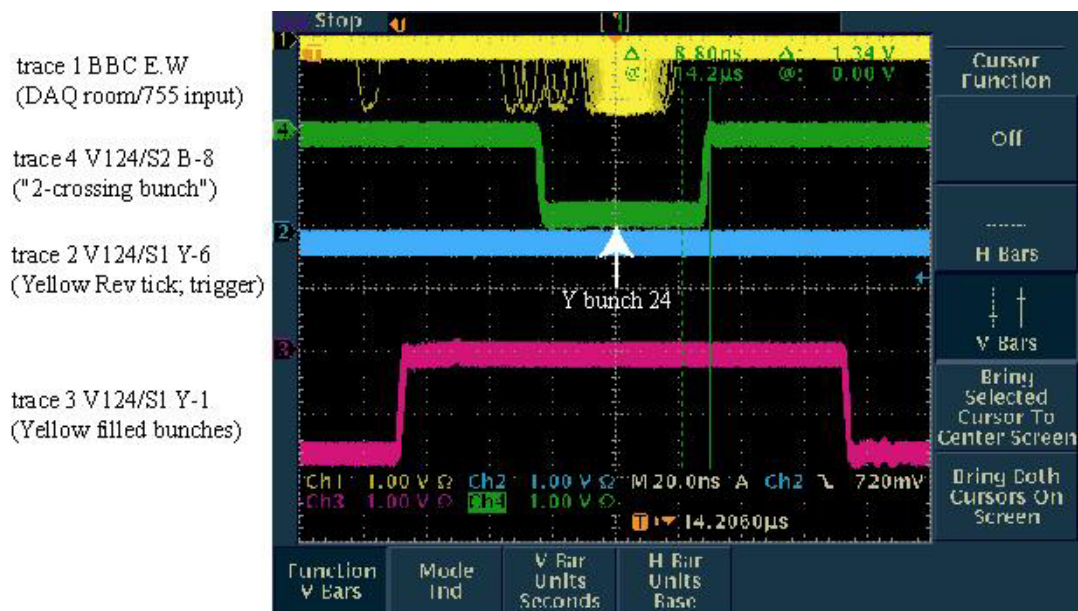
Figure 3 Accumulation of ~10 seconds of triggers with equal coarse and fine delay settings on V-124/set-1 Yellow channels 1,6 and V-124/set-2 Blue channel 8. This scope trace establishes what phase delays are necessary for V-124/set-2 channel 6,7,8.

3) The delay settings of the V-124/set-2 Blue channels 6-8 were set to coarse delay = 339 ticks and fine delay = 16 ns. The resulting scope traces are shown in Fig. 4,5. Note, the V-124/set-1 Yellow channel-1 timing was not changed, and trace 3 is irrelevant.



V124 coarse delay = 95 ticks V124 fine delay = 0 ns
for channels Y-1,6 (Yellow) set 1 (S1),
V124 coarse delay = 339 ticks V124 fine delay = 16 ns
for channels B-8 (Blue) set 2 (S2).

Figure 4 Accumulation of ~10 seconds of triggers with final delay settings on V-124/set-2 channel 8. A zoomed version of this to show the fine timing is in Fig. 5.



V124 coarse delay = 95 ticks V124 fine delay = 0 ns
for channels Y-1,6 (Yellow) set 1 (S1),
V124 coarse delay = 339 ticks V124 fine delay = 16 ns
for channels B-8 (Blue) set 2 (S2).

Figure 5 Accumulation of ~10 seconds of triggers with final delay settings on V-124/set-2 channel 8. The time scale is set to zoom in on Yellow bunch 24.

4) Overlap coincidences were formed between Blue channels 6,7 and 8 of the V-124/set-2 and the BBC E.W signal after setting the final delays. The output from these overlap coincidences were sent to channels of the RHIC scaler specified in the table below.

Coincidence	Definition	Scaler Channel
(V-124/set-2 Blue channel 8)•(BBC E.W)	2-crossing collisions	9
(V-124/set-2 Blue channel 7) •(BBC E.W)	3-crossing collisions	10
(V-124/set-2 Blue channel 6) •(BBC E.W)	4-crossing collisions	11

Things to do

- 1) Set a physical pattern of 2-, 3- and 4-crossing bunches on V-124/set-2 Blue channels 6-8. Our understanding is that with collisions at IP2,6,8 and 10, we will see BBC E.W coincidences at STAR only for 2- and 4-crossing bunches. The bunches that undergo 3 crossings are in either the Blue or Yellow abort gap at STAR.
- 2) Confirm that the ratio of counts in RHIC scaler channels 9-11 agrees with an analysis of STAR bunch crossing data, similar to what is shown in Fig. 1.
- 3) Additional channels of RHIC scalers are required if we are to make similar overlaps for spin-sorted scalers.